What is claimed:

1. A radiation curable resin composition, containing essentially no volatile organic components, comprising:

at least one vinyl dioxolane end-capped oligomer, and

at least one photoinitiator to initiate radiation cure of the oligomer.

2. The radiation curable resin composition of claim 1, wherein the radiation cure of the oligomer comprises UV, visible light or electron beam cure.

3. The radiation curable resin composition of claim 1, wherein the radiation cure of the oligomer comprises UV-cure.

4. The radiation curable resin composition of claim 1, wherein the vinyl dioxolane end-capped oligomer comprises a polyester, acrylate, polyurethane, or copolymers or blends thereof.

5. The radiation curable resin composition of claim 4, wherein the vinyl dioxolane end-capped oligomer comprises a polyester.

6. The radiation curable resin composition of claim 5, wherein the polyester is derived from at least one ester of a polycarboxylic acid.

7. The radiation curable resin composition of claim 6, wherein the ester is dimethyl adipate or dimethyl 1,4-cyclohexanedicarboxylate.

8. The radiation curable resin composition of claim 4, wherein the vinyl dioxolane end-capped oligomer comprises a polyurethane.

9. The radiation curable resin composition of claim 8, wherein the polyurethane is derived from at least one isocyanate or polyisocyanate having the formula

$$R_6(NCO)_p$$

wherein R_6 is an aliphatic or cycloaliphatic alkyl group having from 1 to about 10 carbon atoms or an aromatic group and p is at least 1, or

at least one isocyanate-endcapped aliphatic urethane prepolymer having the formula

$$OCNR_9HNC(=O) - O - R_8 - OC(=O)NHR_7NCO$$

wherein R_7, R_8 and R_9 are independently an aliphatic or cycloaliphatic alkyl group having from 1 to about 10 carbons.

10. The coating composition of claim 8, wherein in the polyurethane is derived from at least one uretdione, isophorone diisocyanate, hexamethylene diisocyanate, 4,4-bis(cyclohexyl)methane diisocyanate, bis(4-isocyanato-cyclohexyl)methane, 1-methylcyclohexane-2,4-diisocyanate, 4,4',4"-tricyclohexylmethane triisocyanate, toluene diisocyanate (TDI), methylene-bis-diphenylisocyanate (MDI), and nathalene diisocyanate.

11. The radiation curable resin composition of claim 8, wherein the polyurethane comprises the reaction product of at least one aromatic isocyanate or polyisocyanate.

12. The radiation curable resin composition of claim 11, wherein the polyurethane is derived from tetramethyl xylene diisocyanate (TMXDI).

13. The radiation curable resin composition of claim 4, wherein the vinyl dioxolane end-capped oligomer comprises an polyurethane acrylate.

14. The radiation curable resin composition of claim 13, wherein the polyurethane acrylate comprises CN985-B88, CN963-B80, CN964-B85, CN-965-A80 and CN966-J75.

15. The radiation curable resin composition of claim 13, wherein the polyurethane acrylate comprises the reaction product of an acrylate and at least one of a branched polyfunctional isocyanate, aliphatic isocyanate-terminated urethane prepolymer, or aliphatic isocyanate-terminated polyester.

16. The radiation curable resin composition of claim 14, wherein the polyurethane acrylate comprises the reaction product of an acrylate and at least one aliphatic isocyanate-terminated urethane prepolymer.

17. The radiation curable resin composition of claim 15, wherein the aliphatic isocyanate-terminated urethane prepolymer has a molecular weight ranging from about 500 to 1000.

18. The radiation curable resin composition of claim 16, wherein the aliphatic isocyanate-terminated urethane prepolymer has a molecular weight ranging from about 500 to 600.

19. The radiation curable resin composition of claim 13, wherein the polyurethane acrylate comprises the reaction product of an acrylate and at least one HMDI-terminated polyethyleneadipate aliphatic urethane prepolymer.

20. The radiation curable resin composition of claim 1, wherein the vinyl dioxolane end-caps comprise substituted or unsubstituted vinyl hydroxy alkyl dioxolanes and vinyl carboxy alkyl dioxolanes, having from 2 to about 10 carbons.

21. The radiation curable resin composition of claim 19, wherein the vinyl-dioxolane end-caps are derived from 2-vinyl-4-hydroxybutyl-1,3-dioxolane (HBVD) or 2-vinyl-4-hydroxymethyl-1,3-dioxolane (HMVD).

21 ~~22~~. The radiation curable resin composition of claim 1, wherein the photoinitiator comprises at least one alpha hydroxy ketone.

22 21 ~~23~~. The radiation curable resin composition of claim ~~22~~, wherein the alpha hydroxy ketone comprises a polymeric hydroxy ketone.

23 ~~24~~. The radiation curable resin composition of claim 1, wherein the photoinitiator is added in amounts of from about 0.5 to about 10 weight percent.

24 ~~25~~. The radiation curable resin composition of claim 1, wherein the photoinitiator is added in amounts of from about 2 to about 6 weight percent.

25 ~~26~~. The radiation curable resin composition of claim 1, wherein the photoinitiator is added in amounts of from about 4 to about 5 weight percent.

26 ~~27~~. The radiation curable resin composition of claim 1, wherein the coating composition is sprayable.

27 26 ~~28~~. The radiation curable resin composition of claim ~~27~~ further comprising a reactive diluent.

28 27 ~~29~~. The radiation curable resin composition of claim ~~28~~, wherein the reactive diluent comprises at least one unsubstituted or monosubstituted vinyl dioxolane monomer.

29 28 ~~30~~. The radiation curable resin composition of claim ~~29~~, wherein the vinyl dioxolane monomer comprises a polyester vinyl dioxolane (PEVD).

30 27 ~~31~~. The radiation curable resin composition of claim ~~28~~, wherein the reactive diluent is added in amounts of up to about 50 weight percent.

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~~32.~~ The radiation curable resin composition of claim ~~31~~, wherein the reactive diluent is added in amounts of up to about 25 weight percent.

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~~33.~~ The radiation curable resin composition of claim ~~32~~, wherein the reactive diluent is added in amounts of up to about 10 weight percent.

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~~34.~~ The radiation curable resin composition of claim ~~28~~, wherein the reactive diluent has a viscosity from about 10 to about 200 mPa•s at about 23° C.

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~~35.~~ The radiation curable resin composition of claim 1 further comprising a pigment.

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~~36.~~ The radiation curable resin composition of claim ~~35~~, wherein the pigment is selected from titanium dioxide and carbon black.

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~~37.~~ The radiation curable resin composition of claim ~~35~~, wherein the pigment is added in amounts of about 0.1 to 30 weight percent.

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~~38.~~ The radiation curable resin composition of claim ~~37~~, wherein the pigment is added in amounts of about 1 to about 25 weight percent.

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~~39.~~ The radiation curable resin composition of claim ~~35~~, wherein the photoinitiator comprises at least one of polymeric hydroxy ketone, trimethylbenzophenone, methylbenzophenone, benzyl dimethyl ketal, benzophenone.

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~~40.~~ The radiation curable resin composition of claim 1 wherein the one vinyl dioxolane end-capped radiation curable oligomer is derinved from 2-vinyl-4-hydroxybutyl-1,3-dioxolane (HBVD), tetramethyl xylene diisocyanate (TMXDI) and an alpha hydroxy ketone photoinitiator.

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~~41.~~ The radiation curable resin composition of claim 1 further comprising a co-initiator.

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~~42~~. The radiation curable resin composition of claim ~~41~~, wherein the co-initiator is a reactive amine.

~~43~~. The radiation curable resin composition of claim 41, wherein the co-initiator is selected from Sartomer CN381, Sartomer CN384 and Sartomer CN386.

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~~44~~. The radiation curable resin composition of claim ~~41~~, wherein the co-initiator is added in amounts of from about 0.1 to about 5 weight percent.

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~~45~~. The radiation curable resin composition of claim ~~41~~, wherein the co-initiator is added in amounts of from about 3 to about 5 weight percent.

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~~46~~. The radiation curable resin composition of claim 1 further comprising a wetting agent.

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~~47~~. The radiation curable resin composition of claim ~~46~~, wherein the wetting agent is added in amounts of from about 0.1 to 0.5 weight percent.

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~~48~~. The radiation curable resin composition of claim 1 further comprising a coupling agent.

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~~49~~. The radiation curable resin composition of claim ~~48~~, wherein the coupling agent is a silane coupling agent.

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~~50~~. The radiation curable resin composition of claim ~~48~~, wherein the coupling agent is added in amounts of from about 0.5 to about 1.5 weight percent.

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~~51~~. The radiation curable resin composition of claim 1 further comprising a thixotropic agent.

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~~52~~. The radiation curable resin composition of claim ~~51~~ wherein the thixotropic agent is fumed silica.

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~~53.~~ The radiation curable resin composition of claim ~~51~~, wherein the thixotropic agent is added in amounts of from about 0.1 to 10 weight percent.

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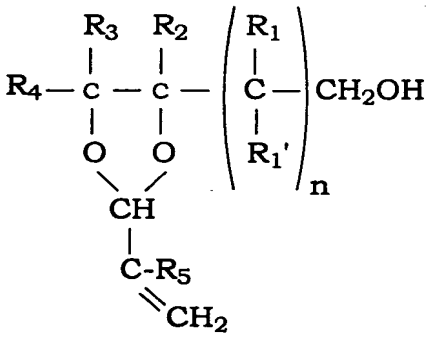
~~54.~~ A radiation curable resin composition, containing essentially no volatile organic components, comprising the reaction product of:

(a) at least one polyester prepolymer which comprises the reaction product of

(1) at least one substituted vinyl dioxolane monomer having the formula



wherein R_1 and R_1' are independently hydrogen or an alkyl group having from 1 to 10 carbon atoms, n is a number from 0 to about 10, and R_2, R_3, R_4, and R_5 are independently hydrogen or an alkyl group having from 1 to about 10 carbon atoms; and

(2) at least one

(i) ester of a polycarboxylic acid; or

(ii) hydroxy-functional acrylate; or

(iii) at least one isocyanate or polyisocyanate; or

(iv) at least one isocyanate-endcapped aliphatic or aromatic urethane prepolymer, and

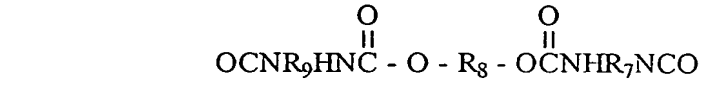
(b) at least one photoinitiator to initiate UV of visible light cure of the composition.

53 55. A radiation curable resin composition of claim 52 54 wherein the at least one isocyanate or polyisocyanate has the formula

$$R_6(NCO)_p$$

wherein R_6 is an aliphatic or cycloaliphatic alkyl group havingfrom 1 to about 10 carbon atoms or an aromatic group and p is at least 1, and

wherein the least one isocyanate-endcapped aliphatic urethane prepolymer has the formula



wherein R_7, R_8 and R_9 are independently an aliphatic or cycloaliphatic alkyl group having from 1 to about 10 carbons.

54 52 56. The radiation curable resin composition of claim 54, wherein the vinyl dioxolane monomer comprise substituted or unsubstituted vinyl hydroxy alkyl dioxolanes and vinyl carboxy alkyl dioxolanes, having from 2 to about 10 carbons.

55 54 57. The radiation curable resin composition of claim 56, wherein the vinyl dioxolane monomer is 2-vinyl-4-hydroxybutyl-1,3-dioxolane (HBVD) or 2-vinyl-4-hydroxymethyl-1,3-dioxolane (HMVD).

56 58. A method of providing a radiation curable polymer coating, the method comprising applying a radiation curable resin composition containing essentially no volatile organic components and enabling radiation cure of the resin composition, wherein the radiation curable resin comprises:

at least one one vinyl dioxolane end-capped oligomer, and at least one photoinitiator to initiate radiation cure of the composition.

57 21 59. The radiation curable resin composition of claim 22, wherein the photoinitiator comprises a mixture of an oligomeric alpha hydroxy ketone and 2-hydroxy-2-methyl-1-phenyl 1-propanone.

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60. The radiation curable resin composition of claim 22, wherein the photoinitiator comprises 70 wt% of oligo(2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl]propanone]) and 30 wt% of 2-hydroxy-2-methyl-1-phenyl 1-propanone.

59 21

61. The radiation curable resin composition of claim 22, wherein the photoinitiator comprises a blend of 2,4,6-trimethylbenzoyldiphenylphosphine oxide, alpha-hydroxyketone and benzophenone derivative.

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62. The radiation curable resin composition of claim 1, wherein the photoinitiator comprises 2 hydoxy-2-ethyl-phenyl-1-propane.

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63. The radiation curable resin composition of claim 1, wherein the photoinitiator comprises bis(2,4,6-trimethylbenzoyl)-phenylphosphineoxide.

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64. The radiation curable resin composition of claim 1, wherein the photoinitiator comprises 1-hydroxy cyclohexyl phenyl ketone.

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65. The radiation curable resin composition of claim 1, wherein the photoinitiator comprises bis η^5-2,4-cyclopentadien-1-yl)bis(2,6-difluoro-3-(1H-pyrrol-1-yl)phenyl)titanium.

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66. The radiation curable resin composition of claim 1, wherein the photoinitiator comprises at least one of an alpha hydroxy ketone, a polymeric hydroxy ketone, trimethylbenzophene, methylbenzophenone, 2 hydroxy-2-ethyl-phenyl-1-propane, phosphine oxide, bis(2,4,6-trimethylbenzoyl)-phenylphosphineoxide, 1-hydroxy cyclohexyl ketone, benzyl dimethyl ketal, trimethylbenzophenone, benzophenone, and bis η^5-2,4-cyclopentadien-1-yl) bis(2,6-difluoro-3-(1H-pyrrol-1-yl) phenyl) titanium.

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67. The radiation curable resin composition of claim 28, wherein the reactive diluent comprises at least one of diethylene glycol diacrylate (DGD), tetrahydrofurfuryl acrylate, 2-phenoxyethyl acrylate, isooctyl acrylate,

propoxylated neopentyl glycol diacrylate, triethyleneglycol diacrylate, hexanediol diacrylate, lauryl acrylate or trimethylopropane triacrylate (TMPTA).

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68. The radiation curable resin composition of claim 1 further comprising at least one thermal cure catalyst to initiate thermal cure of the oligomer.

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69. The radiation curable resin composition of claim 68, wherein the thermal cure catalyst is at least one of a peroxide or cobalt composition.

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70. The radiation curable resin composition of claim 69, wherein the thermal cure catalyst is a peroxide combined with at least one transition metal soap.

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71. The radiation curable resin composition of claim 69, wherein the peroxide is a high temperature peroxide comprising at least one of a tertiary butyl perbenzoate, 2,5-dimethyl-2,5-di(t-butylperoxy)hexane, dicumylperoxide, benzoyl peroxide and MEK peroxide.

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72. The radiation curable resin composition of claim 1 further comprising at least one filler.

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73. The radiation curable resin composition of claim 72, wherein the filler is an organic filler, inorganic filler or blends thereof, comprising at least one of Ni coated carbon powder, iron powder, titanium dioxide, carbon black and thiokol blue.

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